

2003B094-US
Response to Restriction Requirement
Response Dated October 3, 2005

Listing of Claims

WHAT IS CLAIMED IS:

1. (Original) A process for isomerizing xylenes present in a feed containing ethylbenzene comprising:

contacting said feed under conversion conditions with a catalyst system containing a first catalyst and a second catalyst, said first catalyst being unselectivated and comprising: (a) an intermediate pore size zeolite; (b) at least one hydrogenation component to deethylate ethylbenzene; and (c) an amorphous binder, said first catalyst requiring at least 50 minutes to sorb 30% of the equilibrium capacity of ortho-xylene at 120°C and at an ortho-xylene partial pressure of 4.5 ± 0.8 mm of mercury; and said second catalyst comprises an intermediate pore size zeolite and requires less than 50 minutes to sorb 30% of the equilibrium capacity of ortho-xylene at 120°C and at an ortho-xylene partial pressure of 4.5 ± 0.8 mm of mercury;

wherein the amount of said first catalyst present in said catalyst system is an amount greater than 55 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

2. (Original) The process recited in Claim 1, wherein the amount of said first catalyst present in said catalyst system is an amount greater than 60 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

3. (Original) The process recited in Claim 1, wherein the amount of said first catalyst present in said catalyst system is an amount of at least 75 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

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4. (Original) The process recited in Claim 1, wherein the conversion conditions include a temperature from about 315 to about 537°C, a pressure of from about 0 to about 500 psig, a weight hourly space velocity of between about 0.01 and about 200 hr⁻¹, and a hydrogen to hydrocarbon molar ratio of between about 0.05 and about 10.

5. (Original) The process recited in Claim 1, wherein said feed has an ethylbenzene content in the range of from about 5 to about 60 weight percent, an ortho-xylene content in the range of from 0 to about 35 weight percent, a meta-xylene content in the range of from about 20 to about 95 weight percent and a paraxylene content in the range of from 0 to about 15 weight percent.

6. (Original) The process recited in Claim 1, wherein said feed has an ethylbenzene content from about 25 to about 60 wt. %.

7. (Original) The process recited in Claim 1, wherein said intermediate pore size zeolite of said first catalyst and second catalyst is selected from the group consisting of ZSM-5, ZSM-11; ZSM-12; ZSM-21; ZSM-22; ZSM-23; ZSM-35; ZSM-38, ZSM-57; and ZSM-58.

8. (Original) The process recited in Claim 7, wherein said at least one hydrogenation metal of said first catalyst is Pt or Re.

9. (Original) The process recited in Claim 1, wherein said intermediate pore size zeolite present in said first catalyst and said second catalyst is ZSM-5.

10. (Original) The process recited in Claim 9, wherein said intermediate pore size zeolite present in said first catalyst has an alpha value from about 100 to about 300.

11. (Original) The process recited in Claim 9, wherein said intermediate pore size zeolite present in said second catalyst has an alpha value of less than about 100.

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12. (Original) The process recited in Claim 10, wherein the crystals of said intermediate pore size zeolite present in said first catalyst have a crystal size of at least about 1μ .
13. (Original) The process recited in Claim 11, wherein the crystals of said intermediate pore size zeolite present in said second catalyst have a crystal size of less than about 1μ .
14. (Original) The process recited in Claim 9, wherein said amorphous binder of said first catalyst is alumina or silica.
15. (Original) The process recited in Claim 1, wherein at least 30 percent of the ethylbenzene present of the feed is converted to benzene.
16. (Original) The process recited in Claim 1, wherein the feed is contacted with the first catalyst before the feed is contacted with the second catalyst.
17. (Original) The process recited in Claim 1, wherein the process is carried out in a fixed bed reactor.
18. (Original) The process recited in Claim 1, wherein the first catalyst and the second catalyst are in sequential beds.
19. (Original) The process recited in Claim 1, wherein the second catalyst further comprises at least one hydrogenation catalyst.
20. (Original) The process recited in Claim 19, wherein said at least one hydrogenation component of said first catalyst and second catalyst is a Group VII metal or a Group VIIIB metal.
21. (Original) The process recited in Claim 19, wherein the at least one hydrogenation component of the first catalyst and the second catalyst is platinum,

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rhenium, or mixtures thereof.

22. (Original) The process recited in Claim 6, wherein said feed contains up to 30 weight percent of non-aromatics and at least 30 percent of the non-aromatics are hydrocracked.

23. (Original) The process recited in Claim 1, wherein said feed is cascaded over the catalyst system.

24. (Original) The process recited in Claim 4, wherein said temperature is in the range of from about 371 to about 400°C.

25. (Original) A process for upgrading a non-equilibrium feed mixture containing ethylbenzene and at least one xylene isomer with a catalyst system comprising a first catalyst and a second catalyst, said process comprising:

(i) contacting said feed mixture under ethylbenzene conversion conditions with a first catalyst effective under said ethylbenzene conversion conditions to deethylate ethylbenzene in said feed mixture and produce an ethylbenzene-depleted product, wherein said first catalyst consists essentially of: (a) ZSM-5 having an alpha value from about 100 to about 300 and a crystal size of at least 1μ ; (b) a hydrogenation component selected from the group consisting of Pt, Re, and mixtures thereof and, (c) a binder selected from the group consisting of silica, alumina, and mixtures thereof; said first catalyst requiring at least 50 minutes to sorb 30% of the equilibrium capacity of ortho-xylene at 120°C and at an ortho-xylene partial pressure of 4.5 ± 0.8 mm of mercury; and,

(ii) contacting the ethylbenzene-depleted product under xylene isomerization conditions with a second catalyst comprising (a) ZSM-5 having an alpha value less than about 100 and a crystal size no greater than 0.10μ ; (b) a hydrogenation component; and (c) a binder comprising silica, alumina, or mixtures thereof, said second catalyst requiring less than 50 minutes to sorb

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30% of the equilibrium capacity of ortho-xylene at 120°C and at an ortho-xylene partial pressure of 4.5 ± 0.8 mm of mercury;

wherein the amount of said first catalyst present in said catalyst system is an amount greater than 55 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

26. (Original) The process recited in Claim 25, wherein the amount of said first catalyst present in said catalyst system is an amount greater than 60 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

27. (Original) The process recited in Claim 25, wherein the amount of said first catalyst present in said catalyst system is an amount of at least 75 percent by volume based on the sum of the volumes of the first catalyst and second catalyst.

28. (Original) The process recited in Claim 25, wherein the conversion conditions include a temperature from about 315 to about 537°C, a pressure of from about 0 to about 500 psig, a weight hourly space velocity of between about 0.01 and about 200 hr^{-1} , and a hydrogen to hydrocarbon molar ratio of between about 0.05 and about 10.

29. (Original) The process recited in Claim 25, wherein said feed has an ethylbenzene content in the range of from about 5 to about 60 weight percent, an ortho-xylene content in the range of from 0 to about 35 weight percent, a meta-xylene content in the range of from about 20 to about 95 weight percent and a paraxylene in the range of from 0 to about 15 weight percent.

30. (Original) The process recited in Claim 29, wherein said feed has an ethylbenzene content from about 25 to about 60 wt. %.

31. (Original) The process recited in Claim 25, wherein said hydrogenation component of said second catalyst is Pt or Re.

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32. (Original) The process recited in Claim 25, wherein at least 30 percent of the ethylbenzene present of the feed is converted to benzene.

33. (Original) The process recited in Claim 25, wherein the process is carried out in a fixed bed reactor.

34. (Original) The process recited in Claim 25, wherein the first catalyst and the second catalyst are in sequential beds.

35. (Original) The process recited in Claim 25, wherein said feed contains up to 30 weight percent of non-aromatics and at least 30 percent of the non-aromatics are hydrocracked.

36. (Original) The process recited in Claim 25, wherein said feed is cascaded over the catalyst system.

37. (Original) The process recited in Claim 28, wherein said temperature is in the range of from about 371 to about 400°C.